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The Interpretation of Sequent Occupance

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Increasingly the concept of sequent occupance is being used in the description and interpretation of the cultural aspects of landscapes, but as yet there is no agreement as to ways in which aspects of former occupance, reflected in the cultural features of a landscape, should be classified. In some cases popular historical terms such as primitive are used; in others modal terms such as collecting or agriculture; occasionally a mixed classification is employed.

Whittlesey,[1] in the paper in which the concept of sequent occupance was first developed, described in general terms the sequence of modes of occupance in an unnamed small area in northern New England. Though he did not describe the sequence there shown in the order of occurrence, it is possible to identify the following stages: (1) collecting and hunting by Indians, (2) "a thorough-going subjection of the land to farming," (3) a present "transient period in which vestiges of the farming epoch linger on." Whittlesey adds "on this background of the present-day occupance the future can be forecast as an occupance by forests once more, but cut periodically—for wood pulp or possibly lumber."

In this fundamentally important paper no evidence is given that the first mode of occupance (hunting and collecting) left any impress on the landscape that can be identified in the present complex of cultural features which are the results of occupance in stages 2 and 3. The first mode is historically true but its effects are not a part of the present geographic setting.

[1] Whittlesey, Derwent, "Sequent Occupance," *Annals Assoc. Amer. Geogrs.*, XIX (1929): 162–165.

Thomas[2] describes the sequence about St. Louis as successively Pioneer, Farmer, Village, Mining, and Manufacturing—a classification based in part on modes of occupance and in part on population density.

Dodge[3] describes the sequence at Princeton, Illinois, as being Pioneer (along Bureau Creek), First Expansion (on to the prairie), and Completing the Settlement (of the prairie), and indicates the relationship of occupance at the different stages to the physical features of the landscape.

James[4] describes the occupance in different vegetation regions under varying descriptive headings, and in his treatment of the Mediterranean Scrub Forest Lands summarizes the sequence of occupance as the pioneer stage (with scattered settlements), the stage of elaboration ("when the outline of settlement is filled in and begins to show a closer and closer relationship to the underlying qualities of the land"), and a climax stage ("well illustrated in the more densely populated regions of the Mediterranean Basin").

Meyer,[5] in a very interesting historico-geographic study of the Kankakee Marsh, describes the sequence of occupance as chronologically (1) Period of the Indian Hunter and the French Trader, (2) Period of Pioneer Trapper and Frontier Farmer, (3) Period of the Stock Farmer and the Sportsman Fowler, (4) Period of the Corn Belt Farmer and the River Resorter. The modes of occupance at different historical periods are described, but, except for early trails, it is not indicated that early periods of occupance are reflected in the present day cultural landscape.

If in regional descriptions we are to analyze landscapes we should limit our attention to present day landscape features, whether we are dealing with cultural or physical facts. One would not think of attempting in a geographic description to depict the original glacial forms which have been graded and lost in preparing sites for factories or cities in many sections of the northeastern states. Why then should we include historic cultural facts unless they are relict landscape features.

The several instances of usage of the concept sequent occupance above noted show a lack of uniformity in the use of technical descriptive terms, as would be expected in the earlier studies making use of a new point of view. Uniformity in geographic description can only be approached when a usable and detailed classification of occupance forms has been developed. Obviously the basis of any such classification is the mode of occupance.

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[2] Thomas, L. F., "The Sequence of Areal Occupance in a Section of St. Louis, Mo.," *Annals Assoc. Amer. Geogrs.*, XXI (1921) : 75–90.

[3] Dodge, S. D., "Sequent Occupance of an Illinois Prairie," *Bull. Geog. Soc. Phila.*, XXIX (1931) : 205–209.

[4] James, P. E., *An Outline of Geography*, Ginn and Co., 1935.

[5] Meyer, Alfred H., "The Kankakee Marsh of Northern Indiana and Illinois," *Papers Mich. Acad. Sci., Arts and Letters*, XXI (1935) : 359–396.

The larger modes, now well recognized and somewhat generally used, are Hunting and Collecting, Agriculture and Grazing, Mining, Lumbering, Fishing, Industry and Commerce, and Recreational and Institutional Use of the Land. Modes, however, are not always sufficiently definite to be used in the study of small areas, for the cultural features to be seen, though they reflect the mode, are often the result of specialized phases of the mode. It is therefore necessary to analyze modes of occupance and to develop a usable sub-classification that will bring out the specific qualities of occupance. As an illustration of how a mode may be, and in some cases must be divided for study, the mode Agriculture and Grazing may be divided readily into classes, and in some cases the classes can be further subdivided into types and variants of types.

Omitting certain specialized and localized classes of agriculture, like commercial tobacco, potato, or bulb growing, the most common classes of the mode Agriculture and Grazing are primitive agriculture, primitive grazing, extensive grazing, intensive grazing, extensive grain growing, intensive grain growing, general farming (usually including dairying) and plantation agriculture. Each of these classes has a special cultural aspect to be seen in the landscape.

As an instance of the necessity of recognizing classes and types of classes in the classification of a mode, the class Hay and Dairying, as mapped by O. E. Baker, displays many types. Hay may be raised as a cash crop and dairying may be for the production of milk, either for immediate consumption, or for canning, or for making butter and cheese. Each of these sub-divisions of the class Hay and Dairying has certain peculiar landscape features which reflect the mode and indicate the type.

Further, the type of dairying for producing milk to be consumed as milk may have many variants, even within a limited area. Variants from the type depend upon the associated enterprises carried on by a farmer, but all are accessory to dairying which is the core of the farm enterprise.

Davis,[6] in his basal study of agriculture in Connecticut, describes the variants of the type dairying as Dairy-Combination Farms, and lists the following as being found in Connecticut: Dairy-Poultry-Vegetable; Dairy-Fruit; Dairy-Tobacco; Dairy-Forest Products, and Dairy-Outside Labor. In each of these variants, except the last, the cultural aspects of landscape to be mapped will vary from those of the pure type, but yet express the type in certain characteristics. Hence the necessity of such a workable sub-classification of a mode, as a background for field study, and for describing features in a way that will be useful to readers not familiar with the locality under consideration.

[6] Davis, I. G., "Types of Farming and Types of Farming Areas in Connecticut," *Bull. 213, Storrs Agr. Exper. Sta.*

This analysis of the mode Agriculture and Grazing, and of its subdivisions, would seem to indicate that a geographer who, in interpreting an area, finds it necessary to discuss the effects of earlier occupance on the present day landscape, should be careful to make it clear whether he is considering a sequence of modes, or of classes, or of types, or, in special cases, even of variants of a type.

For instance Seattle, Washington, illustrates a sequence of modes, where lumbering was followed directly by a residential occupance, incident to the development of industry and of commerce. In many sections of New England the class general farming has been followed by the mode Recreation.

Where, as in certain portions of the Great Plains, grazing has been followed by extensive grain growing or by irrigation farming, it is a sequence of classes. The change in the Connecticut River Valley from general farming to tobacco growing is a change in types, and changes from dairying to dairy-in-combination, as has been noted above, is a change of variants.

In each case relics of the former occupance may be seen in the landscape and must be interpreted. For the sake of clarity the geographer should record such changes systematically so as to bring out the significance of the change as reflecting changing geographic relationships. These may be due perhaps to increasing competition for the use of the land, or perhaps to economic changes of a national or even an international order.

The field study of small areas in which the recorded sequence is of types, or of variants of types, calls for an appreciation on the part of the geographer of what is and of what is not within his field of study. The geographer is interested in mapping and interpreting uses of the land which may be considered as reasonably permanent in character. On a given farm in New England, for instance, he should map the acreage used (a) for buildings and other utilities, (b) for tillage, (c) for permanent grass, (d) for permanent pasture, (e) for woodland, (f) for orchards and truck gardens.

Inasmuch as the division of tilled land for different crops in many instances varies from year to year, the exact acreage of each crop in a given year is not to be mapped. Changes in acreage distribution may take place from year to year according to whim or to the recommendations of the farm economic experts, but the proportion of tilled to untilled land will as a rule remain practically unchanged over a period of years. Inasmuch as the geographer may not be able to interpret the temporary picture without training in agriculture or farm economics, he should limit his study to the facts of distribution which are indicative of permanent usage and

which can be explained without any study of farm accounts or of the actual labor units devoted to each crop.

This plea for a more systematic approach to the study of modes of occupance, and of sequent occupance, is based on the belief that there will not be real progress in regional geography until the details of both cultural and physical features can be described in terms that are generally understood. Physical features have long been described according to a generally accepted nomenclature, whether they be land forms, soils, drainage patterns or vegetation regions. Progress in the description of cultural features, either of present or past occupance, would seem to require, first, that occupance studies be limited to features to be seen in the present landscape, and second, that an exact sub-classification of each mode be developed as a basis for accurate description of cultural landscape features. This can readily be done for most modes, but is most important for modes involved in a sequent study.

Connecticut State College,
May, 1938.

Methodologic Controversy in Nineteenth Century German Geography*

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CONTROVERSY IN GEOGRAPHIC METHODOLOGY

It is neither accident nor a special love for controversy in academic geographers that has made methodologic discussion a prominent component of their writings and public utterances. The prominence of such discussion is rather the result of a special position of geography among the disciplines represented in academic institutions, a position that presents methodologic problems to every one of its representatives. Each representative has to take a position with reference to these problems, a position that is determined by the influences to which he has been subjected and by his place in the institution of which he is a member. Since these factors vary from individual to individual, it is not a cause for wonder that different geographers have arrived at different and often conflicting personal solutions, nor that they have stated their solutions publicly. Debate concerning the place of geography among academic disciplines is not peculiar to the United States nor to the twentieth century: it has been in progress ever since geography appeared in the universities over a century ago. In examining older methodologic controversies we are not, therefore, merely digging up events that the past has mercifully buried; we are rather looking at the background of contemporary discussion, that has grown out of past controversy and that has an unbroken continuity with it.

The chronicler does not need to apologize for directing attention specifically to controversy rather than toward undisputed methodologic utterances. It is precisely in controversy that logical tools are sharpened to their keenest edge and that participants put forth their conflicting points of view in the clearest words they can command. It is therefore precisely in controversy that we are best able to catch the tendencies of an age. Though the scene of the controversies to be recalled here may at first glance appear remote in place and time, the ideas exhibited in them are still very much alive. For it was in the nineteenth century that the conventions of academic and pedagogic geography with which we live and from which we can not easily escape were established. And it was in Germany that geog-

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raphy first became an academic subject, represented by professorships and institutes in the universities. The form that geography assumed in Germany during the nineteenth century was the model that the rest of the world, consciously or unconsciously, imitated. The ideas that clashed there and then are therefore still, through the continuity of academic tradition, very close to us. If proof of an immediate connection with present-day American geographic thought is asked for, that proof is to be found in the fact that the methodology currently accepted by the majority of American geographers was hammered out in the very controversies to which the following pages are devoted.

The foundations of disharmony in geographic thinking and writing were laid at a much earlier date than the beginning of the nineteenth century. One may, if one chooses, dissect out of the geography of Classical Antiquity two distinct aims in the contemplation of the earth. One was concerned with attaining numerical values for the form and size of the earth and of the lands on its surface, the other with an enumeration and description of these lands and their inhabitants. But while these two tendencies are recognizable, they do not appear, in the writings in which classical geography was restored to Europe at the time of the revival of learning, in conspicuous conflict. The unifying tendency of medieval intellectual activity fused them so successfully that they came through the Middle Ages into modern times so joined as to constitute, in school textbooks and other general compendia, an undivided whole. The inclusion between the covers of the same book of a consideration of the earth as a whole and of the various lands of the earth individually does not strike us today as incongruous, though the combination requires a shift in point of view in passing from the more general to the regional chapters. So well established are the traditions of geographic thought that we are scarcely conscious of the shift, and in textbooks we impose it without hesitation on the minds of children. This familiar and traditional manner of treating the knowledge of the earth is a heritage from the Middle Ages rather than from Antiquity.

So long as the general view of the earth is limited to its geometric qualities—its size and form, and the distribution of land and water and of relief features as they are given by the numerical processes of mapping—the detailed results of such mapping may be combined with regional description as a convenient and not unreasonable background. But through the scientific exploration of the earth that followed the superficial exploration and mapping accomplished in the Age of Discovery there was accumulated, during the seventeenth and eighteenth centuries, a mass of detailed physical information that stretched the modest bounds to which the general discussion of the earth must be limited in treaties of ordinary bulk. There is

already a great deal of such information in Varenius' *Geographia Generalis,* published in 1650. There is a great deal more in the work that has been called "the first physical geography," Torbern Bergman's *Physisk Beskrifning öfwer Jord-klotet,* first published at Uppsala in 1766, the work that in German translation gave the pattern for Immanuel Kant's lectures on physical geography at Königsberg in the last quarter of the eighteenth century. This new material, for which an intellectual frame and a scheme of organization were first provided by Varenius, stood, at the end of the eighteenth century, as something distinct from the traditional compendia of descriptive geography, that swelled into works running to many volumes, and for which the pattern of organization was the pattern of political boundaries as delineated on maps. The stage was set, if occasion should arise, for a conflict between the pursuit of the two intellectual interests represented respectively by descriptive regional geography and by the mass of new physical observations collected in the sixteenth, seventeenth, and eighteenth centuries that did not fit into the traditional descriptions of political units.

THE BACKGROUND OF NINETEENTH-CENTURY CONTROVERSY

The potential conflict might not have been realized had it not been for certain historical accidents that occurred near the beginning of the nineteenth century; certainly it would have little interest for us if the opportunity had not been given for its projection on the academic stage. In the late eighteenth century one could have predicted certain developments in geographic thought. One could have predicted that the physical investigation of the earth would proceed, and at an accelerated rate; that is, that the body of knowledge cultivated by Bergman and Kant would continue to grow and to become more systematic. One could have predicted further that the demand for descriptive, factual information about the several parts of the earth, that can only be organized regionally and for which the accepted organization by political divisions is generally satisfactory, would persist, and so would perpetuate the class of writings represented by the encyclopedic, many-volumed treatises that were the modern successors of the Renaissance editions of Ptolemy. One could not have predicted that the two tendencies would become rivals in the academic field. Out of the complex of events from which arose the controversies to be recounted below I select three wholly unpredictable and almost unconnected happenings without which the development of geographic thought in the nineteenth century must have taken a different course: first, the thorough confusion of political boundaries in Europe that resulted from the Napoleonic conquests; second, the expedition of Alexander von Humbold to America between 1799 and

1804; and third, the appointment of Carl Ritter to a professorship of geography at the University of Berlin in 1820.

The Napoleonic wars shattered and kept in flux for years the familiar pattern of state boundaries on maps, and thus destroyed the traditional basis of organization of descriptive geography. This disturbance was not permanent: after every conspicuous shifting of political boundaries, moreover, descriptive information about the earth that is organized on the basis of political boundaries has to be re-sorted. Yet the way was cleared for organization of the information previously presented by states on a more permanent regional basis. The obsolescence of traditional political boundaries in Europe prepared the ground for Ritter's reorganization of descriptive geographic data by divisions of the continents according to their major relief features.[1]

It is difficult to overestimate the impression made on the intellectual world of the nineteenth century by Alexander von Humboldt's writings. We are accustomed in our own times to the return of expeditions bearing large collections of specimens that are distributed among specialists for identification and description; but we have not been spoiled by the appearance of any considerable number of explorers who possess the comprehensive view that puts a multitude of observations into a symmetrical theoretical system, and in addition the literary ability to present attractively both the observations and the system. Humboldt possessed both these qualities, and well deserved the fame that his exercise of them brought him. He placed his observations and deductions immediately at the service of physical geography: "I had in view a two-fold purpose in the journey of which I now publish the historical account. I wished to make known the countries I had visited; and to collect noteworthy facts pertaining to a science that is as yet scarcely sketched out, that has been rather vaguely named Cosmical Physics (*Physique du Monde*), Theory of the Earth, or Physical Geography. Of these two purposes the latter seemed to me the more important."[2]

[1] The authors of one of the traditional encyclopedic treatises lamented in their preface that they had had to destroy a part of an edition of their work issued between 1799 and 1802, and to begin anew, as a result of the deeds of the Corsican who "thrust his hand violently into the wheel of history."—A. C. Gaspari, G. Hassel, and J. G. Fr. Cannebich, *Vollständiges Handbuch der Erdbeschreibung*, vol. 1 (Weimar, 1819), pp. iv–v. A post-Ritterian, on the contrary, could boast that the "new school" of geography had taken advantage of the confusion in political boundaries during the Napoleonic period to establish, on the foundation of physical geography, a new system of organization.—H. A. Daniel, *Handbuch der Geographie*, vol. 1 (ed. 2, Leipzig, 1866), p. 24.

[2] Alexandre de Humboldt, *Voyage aux régions équinoxiales du nouveau continent . . .*, vol. 1 (Paris, 1816), pp. 3–4.

As physical geography took form in the middle third of the nineteenth century it made abundant and grateful use of Humboldt's contributions. No one can look through the innumerable treatises on physical geography that saw the light during that time without recognizing on almost every page observations that Humboldt had brought back from America, and linguistically elegant generalizations uttered by him somewhere in the great mass of his writings.

But this impact, strangely enough, was not sufficient to overcome the inertia of the traditional descriptive geography. The first official representative of geography in the universities, Carl Ritter, was not the man who could develop academic geography along the lines of the physical earth science that Humboldt envisaged and to which he made so rich a contribution. The repeated obeisances to Humboldt to be found in Ritter's writings do not deceive the reader. With a background in history and pedagogy, he proceeded rather from the traditional descriptive geography. He completely reformed this species of literature by organizing its material on the basis of relief, that has a greater permanence than shifting political boundaries. But his viewpoint was not that of the natural scientist, concerned with reducing to order observations made in nature. The primary material that he sought to bring into orderly form consisted of the accounts of travellers, but of travellers of a pre-Humboldtian type. The accounts of travellers who sought in their writings to satisfy the unspecialized curiosity of the general public and the practical curiosities of the merchant and statesman. The material Ritter worked with was the same as had gone into the older encyclopedic compilations. What gave his reworking of this material its special tendency was the intellectual frame into which he fitted it. His primary concern with humanity, carried over from his early studies in history and reinforced by the philosophic tendencies current in the Germany of the first two decades of the nineteenth century, led him to view the earth from an almost exclusively anthropocentric standpoint. It is difficult to think that a contemporary of Humboldt is serious when he states the purpose of his major work in such words as these: "To present the most important geographic and physical features of the earth . . . in their manifold influences on humanity during the development of its body and mind."[3] It is equally astonishing to find the author of these words, as he grew older, and as at the same time Humboldt's reputation and writings spread more widely through the world, developing more and more clearly the teleologic element in his writings: "In the totality of natural and historical phenomena the effects of the constitution and qualities of the earth appear everywhere,

[3] Carl Ritter, *Die Erdkunde im Verhältniss zur Natur und zur Geschichte des Menschen*, vol. 1 (Berlin, 1817), p. (v).

since it was established from the beginning as the bearer of peoples, as the home, dwelling place, and temporary nursery of the human species."[4] "From the beginning of time a specific function in world history was assigned to each of the continents by its configuration and location."[5] His mystical interpretation was expressed more and more plainly until it became an open admission that he viewed the earth as the place destined by the Creator as the school of humanity during its earthly transition. His geographic methodology merged with natural theology, so that his investigation of the earth became an attempt to discover the purposes aimed at by the Creator in shaping and arranging the lands in the forms in which we know them, in the forms that have molded the characters and destinies of the peoples who inhabit them.

Two so contrasting sets of ideas as those of Humboldt and Ritter, proclaimed simultaneously and both claiming the name of geography, must inevitably come into conflict. The conflict, when it came, was not between the two principals. But there was no lack of more less immediate disciples to clash over the obvious contradiction. All the controversy to be mentioned here may, indeed, be looked upon as representing successive phases of the inevitable conflict between the Humboldtian and the Ritterian views of geography. The names of the principals are not of necessity appealed to by the champions of their respective views, but the continuity of the perennial opposition is clear.

FRÖBEL *vs.* RITTER

Since it was the Ritterian geography that was entrenched in the strong position given it by academic status, the champions of the Humboldtian physical geography were in the position of attackers. The first overt attack on the Ritterian position recorded in the literature dates from the year 1831.

It was in this year that a young man, Julius Fröbel, published in the principal critical German geographic journal an essay on "the present methodologic status of geography."[6] In this essay Fröbel took a position not only in opposition to the unsystematic descriptive geography of tradition, but also and in particular to Ritter, the first unfinished edition of whose "Allgemeine vergleichende Erdkunde" had been published more than a

[4] *Id.*, "Über geographische Stellung und horizontale Ausbreitung der Erdtheile," *Abh. d. k. Akad. d. Wissensch. z. Berlin, 1826, hist.-phil. Kl.*, pp. 103–127. Reference to p. 104.

[5] *Id.*, "Über räumliche Anordnungen auf der Aussenseite des Erdballs, und ihre Functionen im Entwicklungsgange der Geschichten," *ibid.*, 1849, pp. 1–36. Reference to p. 34.

[6] "Einige Blicke auf den jetzigen formellen Zustand der Erdkunde," *Annalen der Erd-, Völker- and Staatenkunde*, ser. 2, vol. 4, 1831, pp. 492–506.

decade earlier, and several of whose shorter essays, in which his methodologic views are more clearly expressed than in the "Erdkunde," had already appeared in the transactions of the Berlin Academy. It was Ritter's methodologic orientation rather than the collection of material represented by the "Erdkunde" that Fröbel attacked. He placed himself first in opposition to Ritter's teleology, in a sentence that cut mercilessly through the mystical wrappings in which Ritter had disguised his objective accomplishments: "Geography can no more look upon the earth as the mere dwelling-place of humanity than the botanist can entertain the view that grass exists only to serve as fodder for cattle." Going further, Fröbel asserted that geography can be conceived only as a purely natural science. Eventually, the facts accumulated through observation of the earth may be fitted into a comprehensive theory, but a complete theoretical treatment of them is not yet possible. In the meantime we may arrive at morphologic generalizations concerning those facts that we can not as yet subsume under dynamic generalizations.

Fröbel attacked Ritter's use of the word "comparative." The units that Ritter pretended to "compare" are the divisions of the land we commonly call continents, but which Ritter had elevated to the half-mystical status of "terrestrial units." To Fröbel, only the earth is a unit; and the individual lands are merely constituents of this unity. But the young critic avoided the mystical contemplation of the whole that formed one of the basic principles of natural philosophy. He asked: "Is it not in the nature of all human knowledge that the total impression must be sacrificed to analysis, that may lead to a new and clearer total impression?" The analysis appropriate to the phenomena of the earth is an analysis into classes, not into regional divisions. When the terrestrial phenomena are classified, comparisons are always instituted within the classes. Comparison is an obvious constituent of this procedure, is in fact implicit in the classification itself: the term "comparative" is superfluous. He argued further that systematic investigation of the classes of terrestrial phenomena had not yet been consistently applied. In this argument Fröbel anticipated by thirty-five years Oscar Peschel's attack on Ritter's use of the term "comparative," and Peschel's demonstrations of the comparative study of the forms of the surface of the earth.[7]

Fröbel concluded, entirely in the spirit of the expanding natural science of his time, that "geography can arrive at significant scientific results only when it has studied separately relief, drainage, atmospheric and climatic phenomena, vegetation, animal life, and humanity, including its settlements and states; separately, but each consistently and in its distribution over the

[7] In his *Neue Probleme der vergleichenden Erdkunde als Versuch einer Morphologie der Erdoberfläche* (Leipzig, 1870). The essays published in this volume had appeared earlier, from 1866 on, in the journal *Das Ausland*, edited by Peschel.

surface of the earth." Geography is thus analyzed into a series of disciplines, each of which develops its own principles, but each of which builds on those that are more fundamental.

This was an attack made by a representative of the analytic scientific point of view, that was to dominate the nineteenth century, on the form that Ritter had given geography. Ritter replied to it, though with evident reluctance, and with the statement that this reply was the first he had made and probably the last he would make to his critics. In his reply[8] Ritter reminded Fröbel that he, Ritter, had long used in his lectures the analytic procedure Fröbel recommended. The purpose of the "Erdkunde" was not to provide textbook material, but rather to be a critical compendium of information concerning the earth that could serve as the basis for further analytic investigations. Such a compendium requires an organization different from that appropriate to a systematic treatise intended as a basis for instruction. The critical collection of material is a necessary preliminary to its analytic organization. Ritter gave his explicit approval to Fröbel's argument that systematic investigation of the earth requires that geography be broken down into a series of analytic disciplines.

This last admission is likely to astonish one who knows only the methodologic utterances Ritter made when writing freely and not under the stress of controversy. It indicates that its author was not so isolated from the scientific tendencies of his age as he sometimes appears to have been. If his life had continued to the impossible length that would have permitted him to complete the grandiose plan of his "Erdkunde," that work might have been crowned by an analytic treatment of the special disciplines Fröbel listed. But Fröbel's attack on his teleology, and on the mystical significance he attached to the great divisions of the land, his "terrestrial units," evidently touched a tender spot. To these rebukes he replied vigorously, but in words dictated by his natural philosophy and theology, not by his rational science:

"Geography is to me no more a pure natural science than is anthropology merely the physics of humanity; for the earth, too, contains a spiritual force, namely mankind itself, as the body contains the soul. When I conceive the physical earth as an organized whole, I do not thereby completely comprehend its essence. I comprehend that essence completely only when I recognize that the earth exists as the nursery and dwelling of humanity; that it therefore has of necessity an ethical purpose and so must possess an organization directed toward ends higher than merely natural ones. For it is a

[8] "Carl Ritter's Schreiben an Heinrich Berghaus, in Beziehung auf den vorstehenden Aufsatz des Hrn. Julius Fröbel," *Annalen der Erd-, Völker- und Staatenkunde*, ser. 2, vol. 4, 1831, pp. 506–520.

divine world created as the home of an immortal soul. . . . Creation and creature can not be separated from each other without shattering their essential fundamental relation. My critic calls the shattering of this great mutual relation a precise definition of science; but wrongly, in my opinion. For all science, however manifold it may be and however sharply it may be divided, is nevertheless at bottom only one, on which all others rest: it can be only the creature's hymn of praise to its Creator; and the contemplation of God is to me the highest, the only absolute science."

Ritter rejected on related grounds Fröbel's objection to his use of the term "terrestrial units" to characterize the continents: these were to him not mere divisions of the lands, but natural wholes, that possess distinctive characters as a result of their peculiar combinations of form, relief, location, arrangement, climate, and organic life.

The conflict in point of view that we are accustomed to look upon as existing between different persons is here recognizable in one person, in Ritter himself; an evaluation of his work must take account of the combination in one man of the critical collector of objective facts with the natural philosopher and theologian.

Fröbel returned to the methodologic argument in the following year.[9] In spite of his sound reasoning, he could not free himself entirely from the traditional inclusion of the human race within the field of phenomena viewed by geography. But he was sufficiently the man of the nineteenth century to see that some aspects of the consideration of humanity as practised in his time could not be included in a geography that works according to the methods of the natural sciences. For him, a thinker unaffected by natural philosophy, there was no metaphysical synthesis such as Ritter could attain, of conclusions derived from observation and conclusions that have a subjective origin. It was particularly to the troublesome problem of humanity as an object of geographic attention that he devoted himself in his second methodologic article. He noted to begin with that no objection had been made to considering geography a natural science if humanity were left out of it. Yet if geography is to comprise the totality of terrestrial nature we can not leave humanity out. The admission of humanity does not necessarily imply the admission of subjectivity. "We can think of a descriptive natural science even if man, including the phenomena of his mind, is included in its field of view." The fact that the expressions of the human mind do not appear as a unit with other phenomena is no obstacle to the formulation of this science, since we do not wholly understand the interaction of all non-human processes. Human phenomena, therefore, stand in this regard on the same plane as other phenomena.

[9] "Ueber die Unterscheidung einer Erdkunde als eigentlicher Naturwissenschaft und einer historischer Erdkunde," *ibid.*, vol. 6, 1832, pp. 1–10.

The sketch of geography as a natural science that Fröbel gave is a very close approximation to the content of the general treatises on physical geography that became common later in the century. The influence of tradition, and of Ritter, the great contemporary reformer of tradition, was, however, strong enough to lead Fröbel to include ethnography among the components of his natural science of the earth. It was, moreover, strong enough to lead him to make room for a second geography besides this one, for a "philosophic-historical" geography, that would look upon the earth specifically as the dwelling-place of humanity. In this anthropocentric geography room could be made for consideration of the subjective effects of the earth on the minds of individuals or groups and for a characterization of regions on the basis of the historical development of the peoples that inhabit them. "So conceived, geography is no longer the lore of the earth as something that contains within itself its own values, as science ordinarily views the objects of its interest. To it the earth's surface is only the scene of the development of humanity and the importance it attaches to physical phenomena is determined by their significance for this process of development."

These passages give, perhaps, a sufficient characterization of the manner in which Fröbel proposed to solve the vexing problem that was inherent in the contemporary status of geography. He did not solve that problem by annihilating one of the two conflicting elements, nor by fusing them in a Hegelian synthesis. Rather, he recognized the validity of two viewpoints from which the earth may be contemplated. The reader is not left in doubt as to Fröbel's preference between these two viewpoints: he may not be wholly wrong if he concludes that Fröbel foresaw that if his natural-scientific geography were permitted to flourish, the devotees of the historical-philosophic geography could be trusted to discredit the discipline of their choice. The separation he advocated would prevent their discrediting all of geography.

In view of the prominent place that the regionalistic idea has been given in recent methodologic discussions, it may be worth while to record the principles according to which Fröbel conceived that the earth might be divided into regions. In judging the principles of division to which he gave utterance it should be remembered that the divisions sanctioned by tradition were (1) political units and (2) the continents. The Napoleonic disturbances had undermined the validity of the first type of unit, and Ritter had given a mystical significance to the second by emphasizing the peculiar combinations of qualities each "terrestrial unit" possesses in its function as the divinely appointed home of certain peoples.

Fröbel's geography as a natural science, looking on the earth as the scene of operation of uniform processes, "knows no individual regions or systems of regions in general, but arrives at divisions of the earth only from special

points of view: for example, divisions based on the distribution of land and water, on geology or plant geography. It has further to investigate whether a division distinguished from one viewpoint preserves its identity when seen from another viewpoint; whether the boundaries drawn on one basis agree with boundaries drawn on others; for coincidence can not be assumed *a priori*."

Human history, on the other hand, provides his historical-philosophic geography with a "basis for dividing the earth's surface into regions in each of which, partly as cause, partly as an effect of the historical development of their inhabitants, all of nature, including the population that has taken form in it, bears its own peculiar physiognomy."

This literary passage-at-arms called forth from the bold young critic of the acknowledged master of academic geography the formulation of principles that much later were realized in practise. Seeing distinctly the internal contradictions of Ritter's conception of geography, Fröbel proposed, first, to exclude all that is subjective from the contemplation of the earth. Since, however, the subjective view of mankind was firmly established, and probably could not be easily eradicated, he proposed on second thought to effect a sharp division between a geography that would be a natural science and a geography that might admit subjective speculation that can not be tolerated in a strictly objective science of the earth. What gives the incident more than passing interest is the accuracy with which Fröbel's proposals sum up developments in geographic methodology during the century following their publication. That century has seen the growth of systematic bodies of knowledge referring to diverse categories of physical constituents of the earth. It has seen these bodies of knowledge partly, though not completely, informed by physical theory. It has seen the rise of an objective ethnography. But it has also seen the subjective and sometimes mystical interpretation of a residuum of information about the life of human groups on the earth. So clearly did Ritter's young critic envisage the conflict between nineteenth-century science and Ritter's geography that his criticism epitomizes the working out of that conflict through and beyond the century in which he and his distinguished antagonist lived.

POST-RITTERIAN INTERLUDE

Unfortunately it was Ritter's mystical interpretation of the earth, divinely created and appointed as the nursery of humanity during its earthly existence, and not his objective organization of factual information, that exerted the strongest influence on his successors; to say nothing of the analytic organization of physical earth science in his unpublished lectures. In the rationalistic intellectual atmosphere of the middle and latter parts of the century, his teachings, interpreted by shallower disciples, could influence

only a small number of serious scholars. Few took the trouble to refute the obscure echoes of those teachings. Oscar Peschel, in the sixties, took up in active practise the suggestion made thirty-five years earlier by Julius Fröbel, and published comparative studies of physical features of the earth. But the opposition that Peschel evoked did not come from the disciples of Ritter, the disciples of the man he accused of never having undertaken a piece of comparative geographic investigation. It came from the geologists, who had independently accomplished by field investigation more than Peschel was able to do by working with maps in the intervals of a busy journalistic career.[10]

From the time of Ritter on, academic representatives of geography have had the task of keeping alive a rather unspecialized body of knowledge in an age of increasingly intense specialization. After a lapse in the sixties of the nineteenth century, German geography grew strong, from 1870 on, as an academic discipline. In the face of the example set by the specialized sciences, and of the criticism directed at it from within and without, it defended itself by the methodologic arguments that are still current in the United States. Its offerings were a combination of systematic physical geography and information—in which ethnography was conspicuous—organized with respect to recognizable divisions of the earth's surface. The most influential defence of this position was Ferdinand von Richthofen's inaugural address at Leipzig in 1883.[11] In this address Richthofen defined pretty accurately the pattern of academic geography followed during the remainder of the century. A recurrent defense was kept up by Hermann Wagner in his periodic reports on geographic methodology in *Geographisches Jahrbuch* from 1878 on.[12] Sooner or later dissatisfaction with the status of geography, which was distinctly out of harmony with the sharp concentration of interest among the other academic disciplines, was bound to be expressed.

[10] J. Spörer, in the first methodologic report published in *Geographisches Jahrbuch*, "Zur historischen Erdkunde. Ein Streifzug durch das Gebiet der geographischen und historischen Literatur," *Geogr. Jahrb.*, vol. 3, 1870, pp. 326–420, made high scholastic sport of the moony philosophizing of Ritter and his followers, from the viewpoint of critical historiography. His criticism is much weightier than Peschel's.

[11] *Aufgaben und Methoden der heutigen Geographie, akademische Antrittsrede* . . . . (Leipzig, Veit & Comp., 1883).

[12] "Der gegenwärtige Standpunkt der Methodik der Erdkunde (1878)," *Geogr. Jahrb.*, vol. 7, 1878, pp. 550–636; "Bericht über die Entwicklung der Methodik der Erdkunde," *ibid.*, vol. 8, 1881, pp. 523–598; "Bericht über die Entwickelung des Studiums und der Methodik der Erdkunde," *ibid.*, vol. 9, 1883, pp. 651–700; "Bericht über die Entwickelung der Methodik und des Studiums der Erdkunde (1883–1885)," *ibid.*, vol. 10, 1885, pp. 539–650; (1885–1888), *ibid.*, vol. 12, 1888, pp. 409–460; (1889–91), *ibid.*, vol. 14, 1891, pp. 371–462.

GEORG GERLAND

It was expressed, and most forcefully, by Georg Gerland, the occupant of the chair of geography at the University of Strassburg. Like many of his contemporary colleagues in German academic geography, Gerland's academic training was in the humanities. He had acquired familiarity with a part of the content of current geographic instruction through working with ethnographic material.[13] But his solution of the methodologic problems he had to face in administering an academic institute was totally different from that arrived at by his colleagues. At an opportune moment, the moment of launching a serial publication as an outlet for dissertations written by his students, he announced in a long and carefully written polemic his divergent views. The serial publication was—and remains—the important *Beiträge zur Geophysik;* the polemic appeared as the editor's preface to the first volume of the *Beiträge,* issued in 1887.[14]

The situation of the critic of accepted geographic methodology in 1887 was far different from that of Julius Fröbel fifty-six years earlier. The practises Gerland was constrained to oppose were not the isolated practises of one man, however eminent, but the established practises of the whole body of academic representatives of geography at the German universities, a body that was backed by a massive array of academic machinery, by libraries of professional writings, and by a well developed periodical literature. One can not suppress a feeling of admiration for the professor at a provincial university who out of inner compulsion rode out to tilt against the entire force of his colleagues. His defiance of the established conventions was the more unexpected in that his own training did not equip him for an active part in the program he set up for academic geography.

As in Fröbel's attack on Ritter, it is the voice of nineteenth-century natural science that again finds utterance in the fifty-four pages of small type that Gerland took for his confession of scientific faith. Not tradition, not academic convenience, but the strict logic of physical science, is the basis of his argument. The earth, the primary object of geographic inquiry, is "an assemblage of matter undergoing development. That development is a tendency toward equilibrium among the diverse components of a complex of matter. . . . The task of geography is to investigate the interaction of the

[13] For a sympathetic account of Gerland's life see Karl Sapper, "Georg Gerland," *Geogr. Ztsch.,* vol. 25, 1919, pp. 329–340.

[14] "Vorwort des Herausgebers," *Beitr. z. Geophysik,* vol. 1, 1887, pp. I–LIV. Gerland's annihilating criticism of the second volume of Friedrich Ratzel's *Anthropogeographie* (*Göttingische gelehrte Anzeigen,* 1893, pp. 697–738) is also a powerful polemic, but reflects no methodologic views that were not already expressed in the essay published in 1887.

forces operating on the material of the earth, and the results of the operation of those forces in the shaping and modification of that material."

Gerland directed his attack immediately against Richthofen's definition of geography—that is not entirely free of sophistry—as the science of the surface of the earth. Richthofen's division of labor between geography and geology was a Solomonic assignment of the surface of the earth to geography and the subsurface to geology. Gerland argued that it was precisely by investigating the surface of the earth that geology had achieved its results; but on the other hand many surface phenomena are unintelligible without a knowledge of the interior. He disposed further of the definition of geography as the science of space-filling terrestrial objects, a windy definition that had long been current: "Knowledge of the heterogeneous objects that occupy space there certainly is; but a science of them is impossible because of their heterogeneity."

Varenius provided the first vague sketch of a qualitative physical science of the earth, and Humboldt gave it a formulation appropriate to modern times. But despite the efforts of Humboldt and of a few others who attempted to develop it further, the physical science of the earth did not take root in Germany. In competition with physical geography "Ritter's Strabonism, formless and obscure as it often was, was victorious. Not only because it remained true to the traditional conception of the task of geography, to present the juxtaposition of things on the surface of the earth, but especially because it fitted in with certain contemporary ideas of Hegelian natural philosophy. It found its greatest number of disciples among historians and students of politics: among scholars not trained in natural science." By such citation of history Gerland sought to disburden geography of the load that Ritter's example had laid on it. It was only an accident, not a logical necessity, that had given geography its anomalous character among the sciences.

Gerland turned next to the ancient tradition of including mankind in the list of objects with which geography is concerned. Fröbel had not been able to free himself from this tradition: even in his natural-scientific geography he had made room for an objective ethnography. Over a half-century later, a half-century of extremely active investigation both of the physics of the earth and of mankind, Gerland, himself an authority in ethnography,[15]

[15] Gerland had won his scientific spurs by completing Theodor Waitz's *Anthropologie der Naturvölker* (6 volumes, of which Gerland worked up vols. 5 and 6 from Waitz's notes, Leipzig, 1858–1872) after Waitz's death in 1864. His regular reports on the progress of ethnography published in *Geographisches Jahrbuch* between 1875 and 1900 fall within the period of his professorship of geography at Strassburg. In the same period he did the most important work of his lifetime, the compilation of the admirable "Atlas der Völkerkunde" (*Berghaus' Physikalischer Atlas*, ed. 3, pt. 7, Gotha, 1892).

boldly thrust all that has to do with mankind out of the field of view of a science of the earth. The methods and points of view appropriate to a physical science of the earth and to the investigation of humanity are too divergent, he argued, to be included within one discipline: "It is impossible that a science possess two heterogeneous methods adapted to two components. There is no possible bridge between the two methods; they are mutually exclusive." One man can not master both the exact natural sciences and the historical sciences. But the separation of a discipline into two divisions destroys its unity; it betrays the fact that one half is only an auxiliary to the other.

If physical geography is combined with historical geography, he continued, the physical component is reduced to the status of an auxiliary discipline, since the knowledge of what humanity has done teaches us nothing about the forces of nature. One studies such a combination not for the sake of knowledge of the earth, that the geographer wishes to acquire, but for the sake of knowledge of the needs and capacities of humanity. "This is true of all the problems of historical geography, or of the branch of learning that Ratzel has called 'anthropogeography': their aim is not knowledge of the earth, but knowledge of mankind; and geography is to them only an auxiliary discipline." It is true of geography as Ritter conceived it. He used the results of geographic investigation to illuminate the history and cultural evolution of mankind. Consequently this branch of learning does not belong in geography, but among the historical disciplines. It is further true of anthropology and ethnology. They can not be parts of geography, since we can learn from them nothing about the nature of the earth.

A further reason for excluding anthropogeography from a geographic science is that it can not claim scientific standing. It does not yield certainties, but at best only probabilities. "Only that which is proved can be learned and is worth learning." Gerland proceeded to demolish the doctrine of "geographic influences" with precisely the same tools that American ethnologists have used so effectively in our own times. "What determines the destiny of peoples," he wrote, "is not their geographic environment, but their character and historical background." The reactions involved are psychophysical, and thus do not lie in a field of geographic thought, but in psychology and physiology.

After clearing the ground by these negative arguments, it was easy for Gerland to set up a coherent program for geographic instruction and investigation. The nucleus of the program is geophysics: the investigation of the forces operating on the materials of the earth, rather than the results of their operation. Mathematics is the geographer's first and most fundamental tool: he may not and will not shrink from its methods of formulation,

but will rather see in them the surest means of solving his most important and most difficult problems. The division of labor within geophysics is according to the media in which the terrestrial forces operate: the solid earth, the seas and other aggregations of water on the earth, and the atmosphere. Around this core are grouped geodesy and cartography, descriptive physical geography that provides observational data for geophysics, and plant and animal geography.

Through such a program, Gerland argued, the traditional objects of geographic attention attain scientific significance. Understanding of the lands can be gained only through geophysics. The distribution of the objects with which the earth's surface is filled attains scientific meaning only when the phenomena that belong together are grouped and when each group is studied individually; when not only the necessity for their distribution but also the whole significance and logic of their distribution is proved. Only when all this work is done by the geographer can the other sciences that have an interest in the earth, the sciences of politics, of commerce, of history, find the material they need and can use, in the form in which they are entitled to ask for it at the hands of the geographer. "The sciences to which geography is auxiliary will be advanced the more effectively the more thoroughly and mthodically the geographer performs his task; they themselves may look after their own fields." The more precisely and scientifically the nature and the natural productivity of a country, that interest the geographer for their own sake, are presented, the more immediately is this information accessible for the use of other sciences.

Fröbel had been unable to free himself entirely from the tradition of including all terrestrial phenomena within the field of geography. He therefore had included in his scientific geography an objective study of humanity. Gerland was able to exclude humanity entirely from the field of concern of the geographer, but not the rest of organic existence, and so listed plant and animal geography among the components of his physical earth science. Both Fröbel and Gerland were prophetic, if one may use the word "prophetic" to mean that they were sufficiently familiar with the scientific tendencies of their respective times to sense the direction in which science was moving. But neither sensed quite how far specialization would go. We can see now that plant and animal geography actually have no logical bond with the other components of Gerland's physical science of the earth. If they are excluded, the remainder is an accurate outline of geophysics as it has developed in the half-century that lies between us and the date of publication of his program. The journal with which he inaugurated his methodologic argument, the *Beiträge zur Geophysik,* carries on today a program of publication that covers precisely the field that for him was the core of geog-

raphy. In the United States, the several sections of the American Geophysical Union[16] reflect in their names his list of the constituents of a physical earth science. The series of manuals issued by the National Research Council under the general title "Physics of the earth"[17] might be used as guides for a program of study such as he contemplated for the aspiring geographer.

For the aspiring geographer, not for some specialist outside the ranks of those who call themselves by that ancient title. Gerland was addressing his colleagues in academic geography. He was prepared for their opposition; prepared, in fact, for the eventuality that his views might "not be listened to at all." But the massive literary apparatus of his day guaranteed an evaluation of his arguments. Hermann Wagner, who wrote the periodic reports on geographic methodology in *Geographisches Jahrbuch,* and who was a good representative of the contemporary trend in academic geography, subjected Gerland's polemic to his customary penetrating but just criticism.[18] Wagner characterized it as "one of the most significant pronouncements in the methodologic field made in the last ten years," and noted that it was the first made by an experienced geographer "that excludes the historical element completely from the field of geography." He recognized that Gerland's proposal tended toward unification of the science, toward the elimination of the dualism—Wagner's term for the inclusion of both physical and human elements—that had characterized both its theory and its practise during the preceding twenty years.

Wagner readily placed his finger on the weak spot in Gerland's methodology: his inclusion of the distribution of plants and animals in a physical earth science. He argued—and we must agree with him today—that the intellectual tools of mathematics and physics will be of little use in the investigation of plant and animal geography. Here the qualitative reasoning currently used in biology is all that is available as an intellectual tool. Moreover, the methods of investigation of the geography of organisms are exactly the same as we should apply to the distribution, migrations, and settlements of human beings, so that if plants and animals are admitted there is little argument for excluding mankind. Thus the unified methodology at which Gerland aimed would not be attained by the adoption of his plan.

[16] Geodesy, seismology, meteorology, terrestrial magnetism and electricity, oceanography, volcanology, and hydrology.

[17] When complete, this series will include the following titles: Volcanology, The figure of the earth, Meteorology, The age of the earth, Oceanography, Seismology, Internal constitution of the earth, Terrestrial magnetism, Field methods for detecting inhomogeneities in the earth's crust, Volcanology, and Hydrology.

[18] "Bericht über die Entwickelung der Methodik und des Studiums der Erdkunde (1885–1888), B, Georg Gerlands Methodik der Erdkunde," *Geogr. Jahrb.,* vol. 12, 1887, pp. 418–444.

This argument, strange to say, is the only logical answer to Gerland's proposal that Wagner, who criticised it more fully than did anyone else, offered. I say "strange," because the sense of such an adverse criticism is only that Gerland did not carry his reasoning quite to its full conclusion. Strange again, that so careful a thinker as Wagner should conceive that he had demolished an argument by pointing out how its logic could be improved. I have been able to find no criticism of Gerland's methodologic proposals that offered a logical rebuttal to the core of his argument, especially if that argument were made more coherent and unified by eliminating the hampering superfluities to which Wagner called attention.

Wagner noted further the resemblance of Gerland's objections to geography as currently practised to those advanced against Ritter by Julius Fröbel over fifty years earlier. They arise from the impatience with the results of investigations of humanity aroused in the minds of those who admire the neatness and elegance of the results obtained by the physical sciences. Such a person "despises all anthropogeographic problems, because they are not capable of precise solution." Gerland's criticisms were to be expected, as a result of the cultivation of physical geography in most of the universities. The tendency those criticisms reflect "has its root not exclusively in the personalities of the majority of present-day representatives of geography, but also springs in part from the spirit of the times, as did the greater appreciation, two generations ago, of Ritter's method. The challenges of Fröbel, that were not appreciated by the historicizing geographers of his time, are now more or less generally accepted, and find in Gerland's utterances a new and more extreme expression. . . . In the demand that the problems of anthropogeography be left to the historian, the political scientist, and the economist, the reviewer [*i.e.*, Wagner] can recognize only an attempt to throw them overboard entirely."

Here was evidently the crucial point. Later in his criticism Wagner recognized the prospect that "geophysics in the narrow sense will apparently become established as a separate discipline between physics and geography." The opponent of Gerland's ideas was thus willing to "throw overboard entirely" the material that formed the nucleus of geography according to Gerland's argument, whether this argument was taken in the form in which its author presented it, or whether its logical leaks were patched up by an inessential change in definition. Wagner's rebuttal of Gerland's methodologic proposals turns out to be a flat refusal to accept the elimination of humanity from the field of concern of geography, a refusal hung on an extremely thin logical thread. His argument, reduced to syllogistic form, would read approximately thus: Geography undertakes the task of investigating the totality of phenomena on the earth's surface. Mankind is among

these phenomena, and therefore forms one of the objects of geographic study. But if the major premise of the syllogism does not hold, Wagner has another argument: If the phenomena associated with the life of mankind on earth are handed over to historians and economists they will not have full justice done to them. Therefore geography must retain them. Wagner displayed no such tender concern for the physical phenomena of the earth's surface, that certainly are also covered by the major premise of the above syllogism, but handed them over without a qualm to "a separate discipline between physics and geography."

The above paraphrase does not quite exhaust the grounds Wagner cited for rejecting Gerland's proposals. He cited numerous practical difficulties in the way of introducing such a program as Gerland's into the universities, given the existing structure of geographic institutes. There is visible through this part of his criticism a poorly disguised fear of disturbing the position geography had attained in the schools and universities.

Wagner returned to the discussion of Gerland's methodology in his next report,[19] and was now able to quote the views of others who opposed it, views that carried an even lighter load of logic than did his own, formulated four years earlier. Now that a considerable number of critics had spoken, and in speaking had rejected Gerland, Wagner was ready to relegate Gerland's proposal definitely to the past. He could now see that Gerland's suggestions for clarifying geographic method represented only the culmination of the emphasis on physical geography that had been prominent for twenty years. Now, if his judgment did not deceive him, "we should find ourselves in a period of reaction against a too exclusive preference for this branch." The voices of his colleagues seemed to him "signs that the dualistic character of geography begins anew to set its mark on today's geographic science, as it has since the most ancient times."

"DUALISM" OVERCOME

But though the majority of geographers, with Wagner in the lead, and riding enthusiastically the steam-roller of tradition, thus won an easy victory over Gerland, the character of "dualism" that Wagner accepted evidently still irked some who were conscious of the contradictory position of an admittedly dualistic science in the rigorously monistic intellectual atmosphere of the late nineteenth century. There is no controversy to report from the attainment of an outwardly monistic synthesis at the end of the century. Wagner noted in his methodologic review of 1891, but only in passing, the emergence of a new formulation of the task of geography: a formulation built on the monographic treatment of regions. Regional geography, that was just coming into Wagner's view in 1891, was set up as the nucleus of

[19] *Geogr. Jahrb.*, vol. 14, 1891, pp. 371–462.

academic geography in the last important German methodologic pronouncement of the nineteenth century, Alfred Hettner's inaugural address at Tübingen in 1898.[20] German geographic methodology was thus able to enter the new century with the dualism that during the nineteenth century had led to repeated controversy at least in appearance healed. Hettner, like Wagner, relinquished geophysics on behalf of geography. He relinquished it willingly, because it "is remote not only from human geography, but also from the geography of plants and animals. It departs from the path that has been marked out for geography by its historical evolution, and is not capable of contributing to the peculiar cultural function of geography, that of serving as a bridge between the natural and the cultural sciences." Hettner's rejection of Gerland's methodology was thus frankly based on tradition; he did not attempt to clothe it in even a thin veil of logic.

Criticism of the synthesis provided by the regionalistic orientation of geography does not belong in the present account. It suffices to remark that this synthesis was only a slight elaboration of the geographic methodology that can be traced back through Richthofen to Ritter, and from Ritter through the compilations of descriptive matter concerning the earth to the collections of travellers' accounts that are so prominent in the literature of the seventeenth and eighteenth centuries. The writings of non-scientific travellers were predicated on unspecialized curiosity in the minds of stay-at-home readers. They therefore included accounts of both the nature and the inhabitants of the lands described. Ritter's vast industry was devoted to a systematization, in the spirit of the historiographic use of documentary materials, of the accumulated writings of these same travellers. The philosophic principles that informed his industry were those of German natural philosophy in the first two decades of the nineteenth century. Those principles were "holistic," in the sense that they forbade the investigator to dissect a whole into its parts for fear of destroying its coherence and so its essential character.[21] Such insight as could be gained was used in the attempt to comprehend a general "earth-nature" or "earth-life," that must include humanity, and that was differentiated over the surface of the earth

[20] "Die Entwickelung der Geographie im 19. Jahrhundert," *Geogr. Ztsch.*, vol. 4, 1898, pp. 305–320.

[21] Siegmund Günther illustrated this holistic view of nature by citing the following stanza from Goethe, who is to be reckoned among the natural philosophers:

"Geheimnisvoll am lichten Tag,
lässt sich Natur des Schleiers nicht berauben;
und was sie Deinem Geist nicht offenbaren mag,
das zwingst Du ihr nicht ab mit Hebeln und mit Schrauben."

Geschichte der anorganischen Naturwissenschaften im neunzehnten Jahrhundert (Berlin, 1901), p. 40.

through the agency of the peculiar combinations of qualities possessed by the several continents and their subdivisions.

Ritter's natural theology did not permit him to look upon humanity as merely one of the coordinate components of this supposed organic terrestrial unity, but led him to place mankind at its focus. The powerful tradition established by Ritter and maintained by his followers remained proof against the forces released by the almost explosive development of the natural sciences in the nineteenth century. The academic representatives of geography were, however, eventually forced by the obsolescence of natural philosophy to abandon the monistic position that natural philosophy gave them, and to assert a dualistic character for their science. Again the intellectual climate, at the end of the century, forced them to retreat from this exposed position. An acceptable synthesis was achieved, in which the holistic view of the earth was modified so as to admit a necessary division of the whole into parts that can be handled by finite human capacities. These divisions were regional; but within any region the components were to be viewed as a whole; very nearly, if not quite, in the spirit of the long discredited natural philosophy. Perhaps Hettner spoke more accurately than he intended when he characterized the position he took in 1898 as a "return to Ritter."

University of California,
July, 1938.

The Land Forms of Chekiang, China[1]

GEORGE B. CRESSEY

The province of Chekiang lies in eastermost China, directly south of the Yangtze estuary. Plate I. (This map and also Plate II are to be found at the end of the article.) In many ways its alluvial plains, steep hillsides and isolated basins provide a sample of the topography in the southern half of the country. Within Chekiang are parts of three of the fifteen physical regions of China. On either side of Hangchow Bay in the north are delta sediments which form part of the Yangtze Plain. In the east are the embayed shorelines and mature mountains of the Southeastern Coast. The western third of the province lies in the South Yangtze Hills. Scattered through the inhospitable mountains which dominate the second and third regions are numerous alluvial-floored basins. In these lowlands and in the coastal plains is concentrated most of the population—one of the densest in all China.

The principal contribution of this study is a detailed map of land forms, Plate II. This is based on field reconnaissance and the analysis of topographic maps. The objective was a quantitative study of surface configuration, designed to be meaningful primarily in terms of potential usability rather than origin or description.

I

The land forms of Chekiang are closely related to the underlying geology, and cannot be understood without reference to the types of rocks and their structure. Only parts of the province have been mapped in geologic detail, but the story is fairly clear. Plate III presents the general outlines.

The most conspicuous geological features are the widespread rhyolite flows. Beneath these Upper Cretaceous extrusions the sedimentary record goes back to the early Paleozoic, while above the rhyolite are Tertiary red beds and recent alluvium.

The older formations include Permian coal and limestone, Devonian quartzite, Silurian sandstone and shale, Ordovician shales, and possibly Cambrian formations. These have an aggregate thickness of over 7,500

[1] Based on field studies in 1934 supported by grants-in-aid from the National Agricultural Research Bureau of Nanking and the National Research Council of Washington.

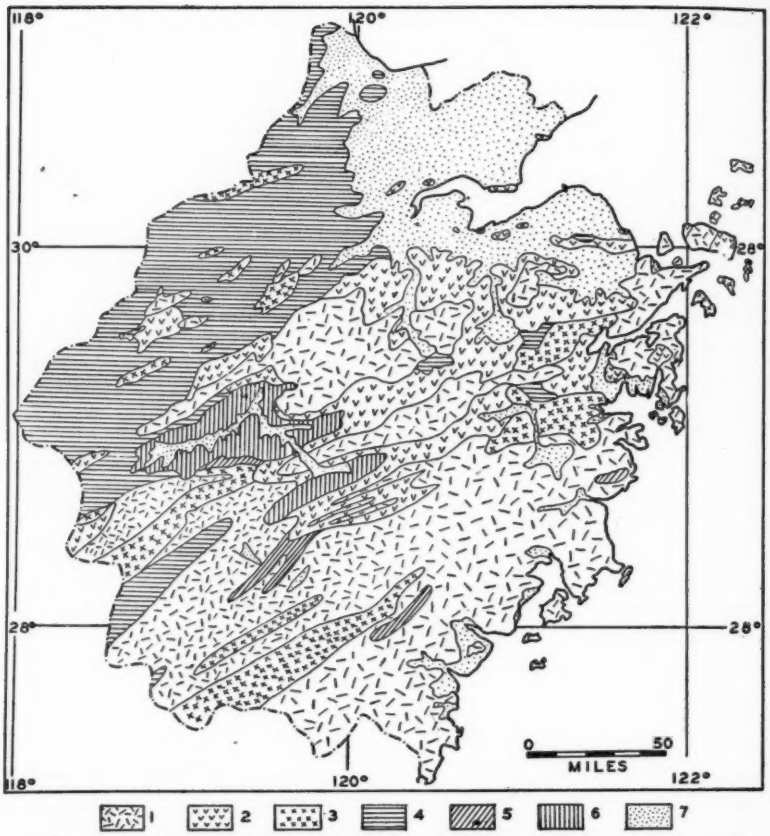

PLATE III.—Generalized Geological Map of Chekiang Province, China. Index to Key: 1, Rhyolite and associated rocks; 2. Tuff and rhyolite; 3, Granite; 4, Paleozoic sediments; 5, Mesozoic sediments; 6, Tertiary red beds; 7, Recent alluvium. Based on Geological Atlas of Eastern Asia, Tokyo (1929).

feet. The exposures are mostly in the west; elsewhere the sediments are deeply buried. Pre-Cambrian gneiss and schist are locally visible.

During the Upper Cretaceous most of the province was buried by thick flows of rhyolite and associated lavas. Despite subsequent erosion, these flows still cover tens of thousands of square miles in Chekiang and Fukien, the adjoining province on the south, probably making this the most extensive rhyolite area on Earth. In several areas the flows aggregate 2,000 feet, while for most of the province the average would be at least a quarter of that figure. Associated with the rhyolite are beds of tuff and

volcanic conglomerates which are hundreds of feet thick. The rhyolite is responsible for much of the rugged topography of Chekiang.

Overlying the volcanics are patches of early Tertiary red beds which accumulated in local basins, often downfaulted. These tilted shales, sandstones, and arkoses strikingly resemble the Triassic of Connecticut. Following their deposition there has been moderate warping. On either side of Hangchow Bay and in scattered embayments along the coast are modern coastal plains and deltas. Interior valleys are locally floored with river silts, the result of down warping or faulting since the mid-Tertiary.

Little evidence of peneplanation is to be seen, and the few accordant summits may be related to flow surfaces. Inter-fluvial uplands are seldom flat, and most summits are small in area. Earth movements have produced numerous anomalies in river valleys, shown in the succession of open basins and narrow canyons. A former erosion surface is suggested by the terraces and even-crested ridges carved on Tertiary and other soft formations which may be as much as 100 feet above the present flood plains.

The entire coast line shows submergence, evidenced by buried beach deposits revealed in deep Shanghai wells and by drowned valleys south of Ningpo. The large extent of delta growth at the mouth of the various rivers suggests that this subsidence is not recent.

II

Many schemes have been devised to represent the height, slope, relative relief, texture or other aspects of the Earth's surface. For much of the Earth, mere elevation is of less human significance than the shape and form of the land. The conventional coloring on so-called physical maps may convey entirely erroneous impressions as to actual forms; thus in Chekiang some areas near sea level usually shown in green are thoroughly dissected, while others at 1000 feet in buff are actually level plains. In the case of Chekiang it is thought that a grouping of slope types is most significant in understanding the lay of the land.

The General Staff of the Chinese Army has prepared topographic maps for most of the provinces. Among the best are those for Chekiang with one series on a scale of 1 : 50,000 and another at 1 : 100,000. The latter set includes 118 quadrangles, 11 by 19 inches, with contours, water bodies, and culture including land use in black and white. These sheets were used as the basis of this study, and parts of several are reproduced in the accompanying illustrations.

The map of Chekiang land forms, Plate II, deals primarily with slope and surface characteristics, and thus gives a significant picture of the configuration. Five types of slope are shown, each of which has its character-

FIG. 1

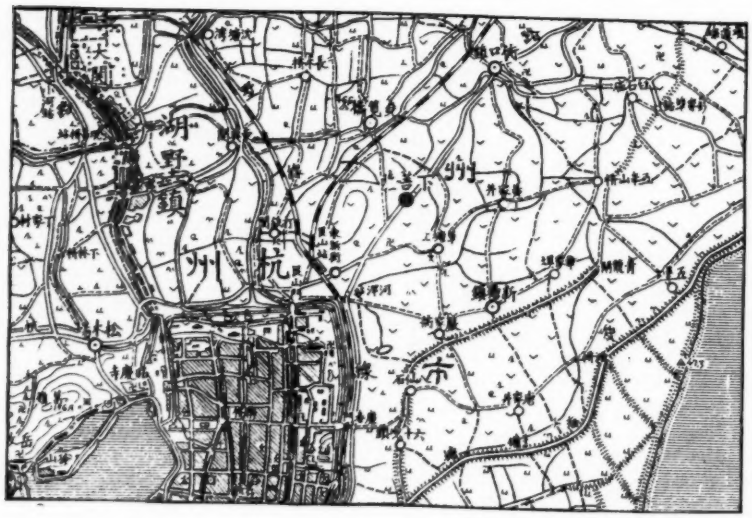

FIG. 2

FIG. 1.—Coastal Flatlands (Group One) in the Yangtze Plain, cut by canals and dotted with settlements. Exact location unknown. (Courtesy China National Aviation Corporation.)

istic relief, texture of dissection, origin, and land use. Only by inference does the map indicate elevation. The slope criteria were established after 2500 miles of field reconnaissance which touched most parts of the province. After studying relationships between lithology, structure, and surface in the field, each map was individually analyzed in the office.

In the preparation of Plate II, each sheet of the 1 : 100,000 series was analyzed in detail, and areas of uniform slopes were determined by the spacing of the 50-meter contours. The resulting data were then plotted on a base map with a scale of 1 : 400,000. Yellow and buff were used for the two types of level lands while orange, brown and purple designated rolling hills, mountains, and precipitous slopes, respectively. These are reproduced on Plate II by appropriate patterns. Locations may be identified by the use of Plate I. The scale of the maps and the large contour interval do not permit detailed accuracy, but the results give a valid picture of the topography.

Group One, called Coastal Flatlands, includes areas where contour lines are essentially absent, so that the slope varies from 0° to 2°. (Figs. 1 and 2.) They occupy 18% of the province. These areas are largely depositional plains such as deltas, river flood plains, reclaimed sea floor, and old lake beds, underlain by fertile clays, silts and sands. The local relief is slight, and elevations are confined to a few feet above sea level. In these plains drainage is largely through a network of canals, which have commonly superseded natural waterways. Swamps have mostly been drained but there are numerous shallow lakes. The Coastal Flatlands have been so thoroughly reworked by man that little trace remains of the original surface.

Group Two, the Interior Lowlands, comprises surfaces where the 50-meter contour lines are more than 5 millimeters apart, giving slopes of 1° to 5° (Figs. 3 and 4). This is a rise of 1 in 100 to 1 in 10. These areas are all in inland basins, usually eroded on soft formations and floored with alluvium. These erosional plains are occasionally several miles in width

FIG. 2.—An area of Coastal Flatlands (Group One) between Hangchow Bay and West Lake. This and subsequent maps are reproduced without reduction from the 1 : 100,000 series of the Chinese General Staff, with a contour interval of 50 meters. Mulberry near the coast is shown by a small v, while rice is indicated in the southeast and northwest by a horizontal bar under two vertical lines.

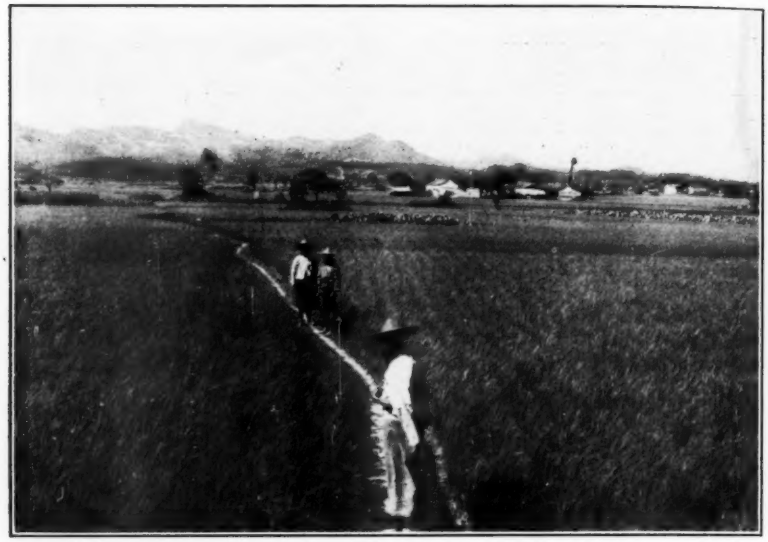

FIG. 3.—Interior Lowlands (Group Two) west of Tientai in the Southeastern Coast. See Fig. 4 for corresponding map.

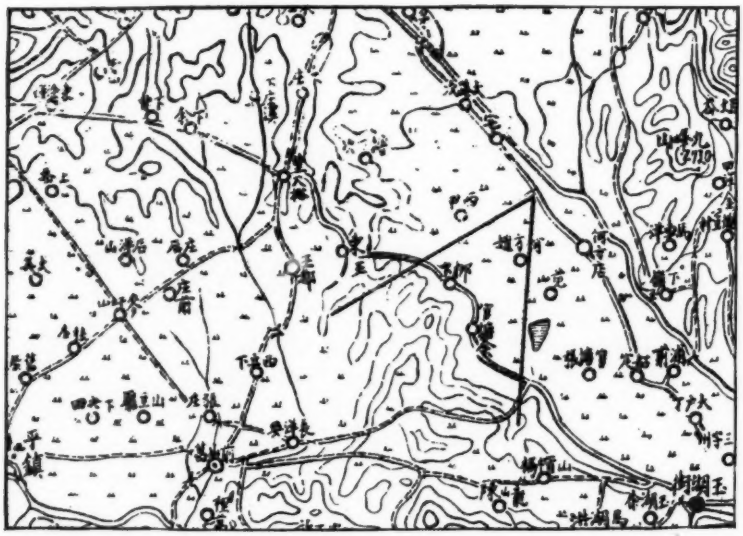

FIG. 4.—An inland basin near Tientai with Interior Lowlands (Group Two) and Rolling Hills. The location of the photograph in Fig. 3 is shown by the large "V". Rice is shown as the dominant crop.

FIG. 5.—Rolling Hills (Group Three) carved on Tertiary red beds in the South Yangtze Hills at Lanchi. In the foreground is a tributary of the Chientang Kiang. See Fig. 6 for corresponding map.

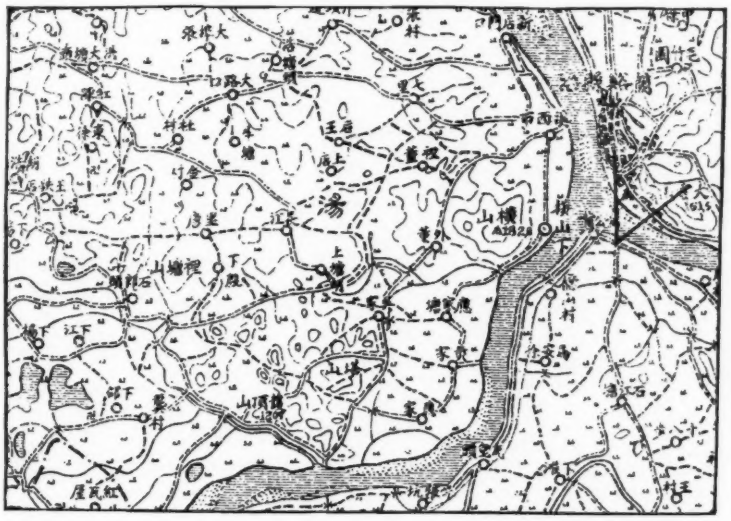

FIG. 6.—The Chientang valley near Lanchi is an area of Rolling Hills (Group Three). Broken lines designate intermediate 25-meter contours. The area of the picture in Fig. 5 is indicated.

FIG. 7

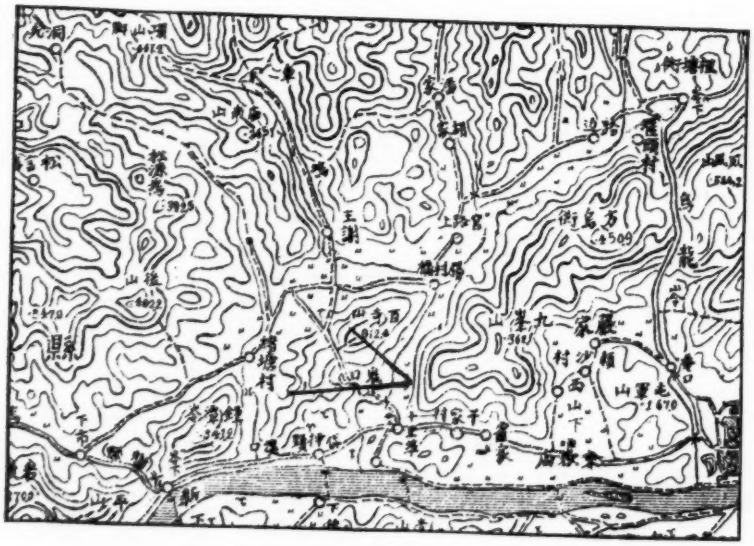

FIG. 8

FIG. 7.—Mountainlands (Group Four) in the South Yangtze Hills west of Yenchow. Tung oil trees and sweet potatoes on the hillsides and rice harvest in foreground. See Fig. 8 for corresponding map.

as in the central basin around Kinhwa, elsewhere the level land may narrow to a few hundred yards. The Interior Lowlands as mapped cover 8% of Chekiang. Scattered basins within the mountains too small to show may increase this figure by 1 or 2%. The local relief is seldom more than 50 feet, and elevations commonly do not exceed a few hundred feet above the ocean, being higher in the more remote interior. Practically all of the land is under cultivation, but the utilization is slightly less intense than in Group One. Canals are uncommon.

Group Three is made up of Rolling Hills. In these slope lands the contours are 2 to 6 millimeters apart, representing an inclination of 4° to 10°, equal to a rise of 1 in 12 to 1 in 4 (Figs. 5 and 6). Rolling Hills are typically associated with structural depressions in which the relatively soft Tertiary formations and poorly consolidated volcanic tuffs have been eroded to gentle slopes. The relief is limited to a few hundred feet, more commonly to tens of feet. Soils are usually infertile so that much of the area is idle. These hilly districts occupy 6% of the province.

Group Four, known as Mountainlands, covers 65% of the entire area. Except in northeastern Chekiang one is never out of sight of mountains. In this group the contour lines are from 1 to 2 millimeters apart, so that the slopes are from 10° to 25°, equivalent to a rise of 1 in 4 to 1 in 2 (Figs. 7 and 8). While the slopes are steep, the mountains are generally rounded and mature. Thin stony soil blankets the slopes, and neither the rhyolite nor the sedimentaries commonly outcrop in bold ledges. Summit elevations range from 2,000 feet to nearly a mile, and the local relief often exceeds a thousand feet. Such level land as may be present is confined to narrow and discontinuous ribbons at the bottom of steep-sided xalleys; level summits are rare. Slopes such as these should not be cultivated, but in some districts fields and orchards are present even on the steepest slopes. Extensive areas are thinly forested and there is a limited but surprising amount of reforestation. Despite the removal of much forest cover, gulleying is not excessive.

FIG. 8.—Mountainland topography (Group Four) with bits of Interior Lowland west of Yenchow. The area included in Fig. 7 is shown.

FIG. 9

FIG. 10

FIG. 9.—Steeplands (Group Five) carved from rhyolite, with red bed hills (Group Three) in the foreground. Near Yunho in the Southeastern Coast. See Fig. 10 for corresponding map.

Group Five includes scattered areas of Steepland where slopes exceed 20°, or approximately 1 in 2 (Figs. 9 and 10). Contour lines in such localities are less than a millimeter apart. This rugged topography is commonly associated with the higher peaks but also occurs in areas of lower elevations where youthful valleys have steep sides. Many of these localities are too small to appear on the map, so that the plotted area of 3% is too low. Bare rock cliffs, rugged mountain peaks and narrow canyons dominate the landscape. Much of the Steepland is associated with rhyolite or the more resistant sedimentaries. There is no cultivation and but little forest. Occasional series of rice terraces may be found on slopes up to 45°.

III

The Yangtze Plain is represented in Chekiang by the Coastal Flatlands between the large lake the Tai Hu, in the north, and Ningpo in the east. The southern boundary next to the hill lands is irregular but obvious. The delta is monotonously flat (Fig. 11), relieved only by canals, grave mounds, and terrace-like mulberry plots where the continual application of canal mud has built up mounds some four feet above the general level. A few half buried hills rise through the sea of mud.

Bordering the sea are a series of maritime dikes, but for which the Spring tides would inundate much of the area.[2] Because of this barrier, drainage in the sub-region north of Hangchow Bay is entirely to the Whangpoo Kiang at Shanghai. South of the Bay the rivers which cross the Coastal Flatlands are bordered by a continuation of the dike system. Within these dikes are polders from which drainage escapes to the sea at low tide. Hangchow Bay is funnel shaped and has a noteworthy bore.

The Southeastern Coast is dominantly Mountainland topography. Along the ocean are discontinuous Coastal Flatlands and within the mountains are

[2] George B. Cressey: "The Fenghsien Landscape," *Geographical Review*, Vol. XXVI (1936), pp. 396–413. (Fenghsien lies just north of Chekiang.)

FIG. 10.—Precipitous slopes characterize many of the higher peaks, which reach 4000 feet in the vicinity of Yunho. The Steepland topography (Group Five) of Fig. 9 is indicated (the photograph was taken from outside the map area). Coniferous forests are indicated by an inverted "V" and deciduous forests by a circle.

FIG. 11.—The Yangtze Plain north of Hangchow Bay is intersected by numerous canals which replace natural drainage ways. Typical landscape in the Coastal Flatlands. Courtesy Mactavish and Co.

isolated Interior Lowlands (Fig. 12). Areas of Rolling Hills are uncommon but there are numerous tracts of Steepland. The coastline is highly irregular, divided about one to two between rugged promentories and delta shoals. There are numerous rocky islands, the most important of which form the Chusan Archipelago in the north.

Rhyolite dominates the area. These flows are slightly folded to give a general structural and topographic trend parallel to the ocean. The irregular mountains of the Southeastern Coast form a continuation of the Wuyi Shan or Bohea Hills which extend from southwestern Fukien northeastward to the Chusan Islands. Near the city of Tientai are the Tientai Shan, while farther south are the scenic Yentang Shan,[3] each rising to some 4,000 feet. Slopes throughout the region are surprisingly steep, and even near the coast often exceed 20 degrees. Most of the area is geomorphically mature.

Several rivers flow eastward to the coast, chief of which are the Wu Kiang which empties into the ocean near Wenchow and the Yungan Kiang at Haimen. Each river cuts through the ranges which parallel the coast in

[3] Herbert C. White and others: "China's Wonderland, Yen Tang Shan," *National Geographic Magazine*, Vol. LXXII (1937), pp. 687-693.

a narrow valley with swift current and rapids, in contrast to the open valleys between the mountains. Drainage tends to be rectilinear. The Wu Kiang has numerous gravel rapids where there is a summer depth of two to three feet, whereas flood waters regularly rise fifteen feet or more. On the tidal portion of the Wu Kiang there are steam launches, elsewhere some 20,000 small junks and rafts penetrate nearly 100 miles. Navigation on other rivers is limited to native craft.

The character of the Southeastern Coast may be illustrated by the Wu Kiang valley from the ocean near Wenchow inland 70 miles to Lishui.[4] The Wu delta is an alluvial plain, intersected by wide canals and studded with rocky hills whose slopes measure from 20° to 30°. From Wenchow inland there are no other sizable areas of level land until Lishui is reached, where a broad basin has been carved on tuff conglomerates at the junction of a major tributary. The few settlements along the river cling precariously to narrow bits of flood plain.

FIG. 12.—Isolated basin of Interior Lowland topography (Group Two) amid the Mountainlands (Group Four) of the Southeastern Coast near Taichow. Rice harvest in progress.

[4] C. T. Yen: "Geology and Mineral Deposits of Wuyie, Sheonping, Lieshiew, Yinhwo, and Yintsa Districts, Chekiang," *Mineral Survey of Chekiang, Bulletin 1* (1932), with map.

Rhyolite underlies about three-quarters of the valley below Lishui, granite and other intrusives, and tuff conglomerates make up a tenth each, and flood plains the remaining five per cent. There is usually an alternation of flows, which may be several hundred feet thick, and tuff, averaging a few tens of feet in thickness.

Apart from the delta the local relief is in excess of a thousand feet. Valley sides are steep, often precipitous. The new automobile roads bordering the Wu Kiang and its tributaries have required much blasting, in places continuously for miles (Fig. 13). Hillsides are usually covered

FIG. 13.—New highway along a tributary of the Wu Kiang north of Lishui. Rhyolite slopes (Group Four) rice terraces, and scattered forest.

with scrub pine. Where slopes are more gentle, the soil sufficiently thick, and irrigation water available, rice terraces mount the valley walls, often with fifty successive steps.

Roughly two-fifths of the province lies in the South Yangtze Hills. In Chekiang this region approximately coincides with the basin of the Chientang Kiang, whose alternate title of Che Kiang or crooked river gives the name to the province. Southeast of the river rhyolite and tuff predominate while to the west folded Paleozoic sedimentaries are more

abundant.[5] Although summit elevations are somewhat higher than in the Southeastern Coast, the local relief is generally less and slopes somewhat less steep. In both regions, Mountainland areas predominate. There are numerous and extensive areas of Rolling Hills and Interior Lowlands. As a result the general aspect of the landscape is less forbidding.

The eastern border of the South Yangtze Hills extends from near Ningpo southwest to the vicinity of Kiangshan. Increasingly toward the south the dividing line is a bold westward-facing rampart, marked by successive areas of Steeplands. As viewed from the upper valley of the Chientang, the boundary is a range rising some two thousand feet above the valley floor, known as the Hsianhsia Shan. The regional boundary generally marks the divide between eastward and northward flowing drainage.

The structure of the region is complicated when examined in detail, but shows a general northeast and southwest alignment. Bordering the Chientang on the west is the Weiling range, a synclinal structure of Silurian sandstone, beyond which appear progressively older formations. The principal mountain making probably occured in the late Jurassic, and was followed by the accumulation of red sandstones and shales in local warped basins both before and after the Cretaceous rhyolite flows.

In the central part of the province, near the eastern margin of the South Yangtze Hills, lies an elongated lowland carved on softer rocks with low hills and broad plains. This is the Kinhwa basin, the most important interior district of Chekiang. The basin has a length of over a hundred miles from northeast to southwest. The middle portion is an Interior Lowland with a width of two to ten miles; on either side are Rolling Hills some three to five miles wide. The area is both down faulted and folded, and is surrounded by Mountainland. Nowhere else in the interior are villages so closely spaced or prosperous, and there are eight important county seats.

The Chientang Kiang is tidal to Fuyang, and small launches reach Tunglu, fifty miles above Hangchow. Beyond Tunglu the river flows through the famous Seven Li Gorge, actually something over two miles long but so swift and difficult to navigate that it is reckoned by Chinese boatman as 70 li for the upstream trip against a head wind. Despite numerous sand bars in various parts of the river, there is a continuous procession of small passenger and freight boats while in the upper reaches bamboo rafts are used. The river is navigable after a fashion almost across the province.

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[5] C. C. Liu and Y. T. Chao: "Geology of Southwestern Chekiang," *Geological Survey of China, Bulletin 9* (1927), with map.

T. Li and V. King: "Geology and Mines along the Hangchow-Kiangshan Railway," *Mineral Survey of Chekiang, Bulletin 2* (1932), in Chinese, with map.

Within the South Yangtze Hills are several noteworthy mountains, principally the Pei Shan, 4281 feet, of Kinhwa, Tienmu Shan, 4937 feet, west of Hangchow and possibly once glaciated,[6] and Mokan Shan, the popular summer resort for foreigners northwest of Hangchow.

IV

Chekiang is at the same time the smallest, one of the most prosperous, and among the more picturesque provinces of China. With an area the size of Indiana, 38,462 square miles, the population numbers 24,139,766. Only 29% is under cultivation, so that the average person has but .28 acre of agricultural land. Despite this handicap, the favorable environment and location, including access to the Shanghai market, have given Chekiang an enviable economic status. The scenery is seldom outstanding, but there are many attractive vistas of mountains and seashore, and half a dozen spots are renowned throughout China.[7]

Wherever slope, soil, and water permit, the land is intensively utilized for agriculture (Fig. 14). Rice in the summer and wheat in the winter are the staple food crops. In addition most areas specialize in one or more of the following: mulberry for silk (Huchow and Hangchow), cotton (Kashing and Shaohing), oranges (Wenchow), peaches (Fenghwa), honey dates (Lanchi), corn for fattening pigs (Kinhwa), sugar cane, tobacco, oil seeds, tea, tung oil, pears, candleberry trees for wax, and beans.

Population densities range from 2000 per square mile in the Coastal Flatlands through 1000 per square mile in the Interior Lowlands and a few hundred per square mile in the Rolling Hills to tens of people per square mile in the Mountainlands and Steeplands.

Since the days of the Southern Sung dynasty (1127–1279) with its capital at Hangchow, Chekiang has continued to hold high rank in culture. When Marco Polo visited Hangchow he described the city as "beyond doubt the finest and noblest in the world." From 1933 to 1937 the National Government concentrated attention on Chekiang in order to make it a model province. The most spectacular of the changes were the 2,000 miles of automobile roads which have revolutionized the accessibility of the mountainous interior.

To a remarkable extent human activities in Chekiang have come into intimate adjustment with its surface forms, so much so that with appropriate

[6] J. S. Lee: "Data Relating to the Study of the Problem of Glaciation in the Lower Yangtze Valley," *Bulletin Geological Society of China,* Vol. XII (1934), pp. 395–432.

[7] G. Yun Chang: "Scenic Features of Chekiang Province," *Journal Geographical Society of China,* Vol. 1, Number 1 (Sept. 1934). In Chinese.

G. Yun Chang: "An Analytical Study of the Scenic Regions in Chekiang," *ibid.,* Vol. 1, Number 2 (Dec. 1934). In Chinese.

FIG. 14.—A village north of Taichow in the Mountainlands, showing intensive land use.

changes in legend Plate II would serve almost as well as a map of population density or agricultural usability. Such is the maturity of the Chinese landscape.

Syracuse University.
June, 1938.

THE LAND FORMS OF CHEKIANG

Group	Description	Per cent of area	Spacing of 50 meter contours on 1 : 100,000 map	Approximate angle of slope	Local relief	Map Symbol
1.	*Coastal Flatlands* Depositional plains such as deltas, river flood plains, old sea floor, former lake beds. Essentially flat; near ocean. Clay, silt, sand; fertile soil. Available for intensive agriculture, dependable irrigation from canals, local drainage problems.	18	No contours.	0°–2°. Flat.	Slight.	
2.	*Interior Lowlands* Inland basins, river plains carved on areas of softer rocks, locally with veneer of alluvium. Nearly flat to gently undulating, with a few low hills. Good silt and sand soil. All in cultivation, few canals.	8	More than 5 millimeters apart.	1°–5° 1 in 100 to 1 in 10 rise.	Slight, under 50 feet.	
3.	*Rolling Hills* Usually carved on areas of Tertiary red beds or volcanic tuffs. Gentle slopes with some areas of nearly level land. Soil generally infertile. Some terracing, largely idle.	6	2–6 millimeters apart.	4°–10° 1 in 12 to 1 in 4 rise.	Tens of feet, occasionally hundreds.	
4.	*Mountainlands* Rounded worn down mountains with steep slopes, characteristically made of rhyolite, mature. Narrow fragments of flood plains in some valleys. Thin stony soil, badly eroded by sheet wash. Unsuited for agriculture, considerable forest.	65	1–2 millimeters apart.	10°–25° 1 in 4 to 1 in 2 rise.	Hundreds of feet, occasionally a thousand.	
5.	*Steeplands* Precipitous slopes of bare rock, cliffs, rugged mountains, or narrow valleys.	3	1 millimeter or less.	20° and over. 1 in 2 rise and steeper.	Hundreds of feet, and often over a thousand.	

Based upon the analysis of 118 maps of the Chinese General Staff (1930), scale 1 : 100,000, contour interval 50 meters, by George B. Cressey.